MULTI-MEDIA COMMUNICATION MANAGEMENT SYSTEM SUPPORTING SELECTABLE APPLIANCE MODULES

Cross-Reference to Related Applications

The present application is a continuation-in-part of United States Patent Application 09/961,532 titled Teledata Space and Docking Station with Modular and Integrated Display filed on September 24, 2001, and is a continuation-in-part of United States Patent Application 10/000,543 filed on October 23, 2001, titled Modular Multi-Media Communication Management System.

Technical Field

The present invention relates generally to managing multi-media communications, and more particularly to a modular system with selectable appliance modules, each of which includes a subscriber interface optimized for providing a type of information to the subscriber.

Background of the Invention

In today's fast paced business world, it is common for a person to rely on a combination of communication devices, such as: desk top telephones, mobile telephones, cellular telephones, fax machines, pagers, radios, televisions, Internet connected computers, and the like, to accommodate their information and communication needs.

In an office environment, desk top telephone service, voice mail service, and fax service is typically provided by a private telephone communication system. A contemporary private telephone communication system consists of a switching network, a plurality of desktop telephones, and a voice mail server. The voice mail server is typically coupled to the switching network using a proprietary interface. Each desk top telephone and fax machine is coupled to the switching network by an extension line that consists of twisted pair conductors that are terminated by a telephone jack in the office. Communication between the desktop telephone and the switching network over each extension line utilizes either proprietary digital signaling or plain old telephone service (POTS) signaling. The switching network is further coupled to the public switched telephone network (Public Switched Telephone Network) using trunk lines that are connected to a central office switch that is typically managed by the local telephone service provider. The switching

network controls calls between extensions and between an extension and a remote destination via a trunk line coupled to the Public Switched Telephone Network. The switching network also routes calls to the voice mail server when an extension remains unanswered, is busy, or is otherwise programmed to route calls to voice mail.

Recently fixed wireless networks have enabled wireless mobile telephones to be supported by the private telephone communication system . A wireless telephone controller is coupled to a wireless network in which a plurality of mobile telephones may be operated. The wireless telephone controller is coupled to the switching network of the private telephone communication system. In operation, each mobile telephone is assigned an extension number and calls directed to that extension are routed to the wireless telephone controller and then to the mobile telephone over the wireless network. Because the mobile telephone is equivalent to a desktop telephone from the perspective of the private telephone communication system, full voice mail services are supported for the mobile telephone.

Internet information services are typically provided by a plurality of content service providers coupled to the Internet and are typically accessed by client software on the person's desktop and/or notebook computer. Internet information may include messaging services such as e-mail and may include information services that provide news reports, stock prices, or other information content available on the web. The information content may be in the form of HTML documents or in the form of real time streaming audio or audio/video files.

A problem associated with utilizing a desk top or notebook computer for Internet information is that the generic user interface of the computer, keyboard, and browser software is adequate for the display of HTML documents, but is not optimized for display of real time audio/video information and is not optimized for the subscriber to interact with the service provider using intuitive and dedicated buttons or other controls.

Another problem associated with using a telephone system for some information and communication services and utilizing the desktop or notebook computer for other information services is that there is a lack of integration and

coordination between the services.

What is needed is a multi-media communication management system that provides coordinated and integrated access to communication services and information content that does not suffer the disadvantages of existing communication systems.

Summary of the Invention

The multi-media communication management system comprises a controller that interfaces with a plurality of communication space stations, and their associated subscriber device(s), and with one or more communication medium service providers.

The controller translates multi-media communications received from a multi-media service provider into the protocols required for use by the communication space stations as well as any conventional telephone stations that may be coupled to the controller. The communication and control signaling between the controller and the communication space stations may be wireless in nature with the communication space stations may each be powered by an internal battery and/or connection to a local source of conventional line power.

The architecture of the communication space station is modular. Multiple functional elements can be interconnected with backbone communication circuitry to form an integrated communication platform. Modular docking interfaces may be used to couple the space station communication device to portable subscriber devices and to appliance modules that have a user interface optimized for specific communication and/or information services. The communication space station integrates and coordinates communication through multiple communication medium service providers. This coordinated and integrated system architecture enables the space station communication device to merge the functionality and internal data of the various portable subscriber devices and appliance modules into the space station communication device, to direct the functionality and data of the space station communication device to a selected one of the portable subscriber devices, and to provide the subscriber with a simple subscriber interface.

For a better understanding of the present invention, together with other and further aspects thereof, reference is made to the following description, taken in

conjunction with the accompanying drawings, and its scope is pointed out in the appended clams.

Brief Description of the Drawings

Figure 1 is a block diagram view of a modular multi-media communication management system;

Figure 2 is a block diagram of a multi-media communication management system controller;

Figure 3 is a perspective exploded view of a modular communication space station;

Figure 4 is a block diagram of a communication space station;

Figure 5 is a block diagram of a subscriber data assistant;

Figure 6 is a block diagram of a wide area network communication device;

Figure 7 is a block diagram of a wireless dialog handset;

Figures 8a is a table diagram representing a current network location table;

Figure 8b is a table diagram representing a multicast group table;

Figure 9 is a block diagram of a first exemplary appliance module;

Figure 10 is a block diagram of a second exemplary appliance module;

Figure 11 is a block diagram of a third exemplary appliance module;

Figures 12a through 12j each show a flow chart representing processing steps performed by a multi-media communication management application;

Figure 13 is a flow chart representing processing steps performed by an exemplary content application;

Figure 14 is a flow chart representing processing steps performed by a module support application;

Figure 15 is a flow chart representing exemplary operation of packet audio/video gateway; and

Figures 16a through 16h each show an exemplary display of information to a subscriber utilizing a subscriber interface of a communication space station.

Detailed Description

The present invention is now described in detail with reference to the drawings. In the drawings, each element with a reference number is similar to other elements with the same reference number independent of any letter

designation following the reference number.

It should also be appreciated that many of the elements discussed in this specification may be implemented in hardware circuit(s), a processor executing software code, or a combination of a hardware circuit and a processor executing code. As such, the term circuit or module as used throughout this specification is intended to encompass a hardware circuit (whether discrete elements or an integrated circuit block), a processor executing code, or a combination of a hardware circuit and a processor executing code, or other combinations of the above known to those skilled in the art.

Figure 1 illustrates a multi-media communication management system 10 which includes a control unit 12 that is coupled with a plurality of local communication devices 20 over a wireless Local Area Network 22 (or by a wired network connection 23 to the backbone wired network of the wireless Local Area Network 22). The local communication devices 20 may include: subscriber stations 24 (communication space stations 24), wireless dialog handsets 26, traditional computer systems 32, and network printers 46. Each subscriber station 24 may include multiple module docking bases 62a, 62b, and 62c for supporting various appliances and subscriber devices that may include data appliance modules 30a and 30b, a display screen 59, or a docking interface module 58 which in-turn supports a subscriber device such as a personal data assistant 86 or a wireless telephone appliance 88.

Appliance modules 30a and 30b may each include a user interface and circuitry tailored to facilitate user interaction and/or display of a particular type of data to a subscriber. For example, appliance module 30b includes a long, narrow display screen and circuits tailored to present a streaming stock ticker display. Appliance module 32a includes a display, speaker, volume control, channel select buttons, and circuits tailored to display streaming audio/video programming from subscriber selected sources.

The control unit 12 includes a Public Switched Telephone Network bay 25 which operatively couples the control unit 12 to one or more subscriber loops of the Public Switched Telephone Network (PSTN) 42 and includes a multi-media communication service provider bay 14 which operatively couples the control unit

12 to a multi-media Service Provider network 18 through one of a plurality of communication medium modules 16a-16d. The multi-media Service Provider network 18 may utilize the Internet Protocol Suite for communication at the IP level, but may be proprietary at the data link and physical layers. As such, the control unit 12 includes the IP stacks applicable for communication between applications over the multi-media Service Provider network 18 and each module 16a-16d includes the applicable data link and physical layer circuits for communication of IP frames over the physical medium of the multi-media Service Provider network 18a-18d.

Some examples of communication modules include: communication module 16a which may be a cable modem module for communicating over coaxial cable 36 with a multi-media communication service provider such as a local cable company, communication module 16b which may be a wide area network radio for communication over a wireless spectrum channel 38 with a wide area wireless multi-media communication service provider such as an analog or digital cellular/PCS telephone service provider, communication module 16c which may be a customer service unit (CSU) for communication over a T1 line 40 with a multi-media communication provider such as a local telephone service provider, and communication module 16d which may be an optical modem for communication over a fiber channel 44 with a fiber optic multi-media communication service provider.

In operation, the control unit 12 integrates and manages multi-media communication between two or more local communication devices 20 and between each local communication device 20 and a remote communication system(s) (not shown) coupled to either the multi-media Service Provider network 18 or the Public Switched Telephone Network 42. As shown in Figure 2, the control unit 12 includes applicable modules for managing the Local Area Network 22 as an IP network. Such modules may include a protocol conversion module 27, an applicable combination of hubs, routers, and switches 29 for managing communications over the Local Area Network 22 as well as an address server 220 (e.g. DHCP server) for assigning local IP addresses to each local communication device 20 as the necessary circuitry 28 to implement the data link and physical layers of the

communication protocol(s). The control unit 12 may also include a packet gateway 232, a voice mail module 236, an e-mail module 228, a web server 230, a Public Switched Telephone Network interface 25, and memory 235.

Packet Gateway

The packet gateway 232 provides a subscriber's real time, full duplex voice communication and audio/video communication services. These services may include routing, maintaining, and selectively recording a subscriber's outgoing calls and incoming calls. A subscriber's outgoing calls may comprise voice calls, audio/video calls, and multi-party conference calls (either voice or audio/video) that are originated by a subscriber's communication space station 24. The destination(s) may include remote packet audio/video devices coupled to the multi-media Service Provider network 18, remote telephones coupled to the Public Switched Telephone Network 42, or other subscriber's served the multi media communication management system 10. A subscriber's incoming calls may comprise calls (either voice or audio/video) that are originated by a remote telephone device coupled to the Public Switched Telephone Network 42, remote packet audio/video devices coupled to the multi-media Service Provider network 18, communication space stations 24, or the audio/video conference module 229.

The packet gateway 232 communicates over the Local Area Network 22 and the multi-media Service Provider network 18 utilizing IP protocols. However, voice communication over the Public Switched Telephone Network 42 utilizes analog or Public Switched Telephone Network digital voice signals. As such, the Public Switched Telephone Network interface 25 includes circuits for translating between Public Switched Telephone Network call signaling (and analog/digital Public Switched Telephone Network voice communication) to digital call signaling messages (and digital voice communication) for use by the packet gateway 232. Therefore, for the sake of simplicity, the discussion of the packet gateway 232 herein refers to Public Switched Telephone Network interface 25 as an originating or destination device with which a voice call may be established and maintained. However, it should be appreciated that the Public Switched Telephone Network interface 25 is not the ultimate origination or destination but is operating to interface the packet gateway 232 to a telephone system on the Public Switched Telephone

Network 42 with which it could not communicate directly.

The packet gateway 232 includes a call signaling module 227.that includes circuits for receiving call signaling messages from an originating device, identifying a destination device, providing call signaling messages to the destination device, and, if responded to by the destination device, negotiating compression algorithms and establishing channel usage for the relay of real time voice or audio/video communications. In the exemplary embodiment call signaling utilizes defined protocols, such as the H.323 protocols promulgated by the International Telephony Union (ITU) or the Session Initiation Protocols (SIP) promulgated by the Internet Engineering Task Force (IETF).

For incoming calls, the call signaling message provided by the originating device may identify a subscriber served by the multimedia communication management system 10. The call signaling module 227 attempts to identify the communication space station 24 that is then serving the subscriber device 50 that is assigned to the identified subscriber. The process of identifying a destination device is illustrated in Figures 15 and 8a. The call signaling message, identifying the subscriber, is received by the call signaling module 227 at step 600. Each subscriber can be assigned a four digit subscriber identifier number that corresponds to the last four digits of a Public Switched Telephone Network direct dial number that routes to the Public Switched Telephone Network interface 25 when dialed on the Public Switched Telephone Network 42. As such, the call signaling message, whether provided by an originating device coupled to multi-media Service Provider network 18, an originating device coupled to network 22, or the Public Switched Telephone Network interface 25, may include the subscriber identifier number to identify the destination subscriber. At step 602, the call signaling module 227 identifies a subscriber device 50 (Figure 1) that is associated with the identified subscriber utilizing the network location table 245. To associate each subscriber with their subscriber device 50, the network location table 245 includes a record for each subscriber. Within such record is a field that identifies the subscriber, the four digit subscriber identifier associated with the subscriber, and a subscriber device ID code that is unique to the subscriber device 50 that is assigned to the subscriber.

At step 604, the call signaling module 227 identifies whether the subscriber device 50 is served by a communication space station 24. The network location table 245 further includes a field that may comprise the network address of the communication space station 24 that is presently serving the subscriber device 50 assigned to the subscriber. The address within this field is updated when the subscriber moves their subscriber device 50 from one communication space station 24 to another. If the subscriber device 50 is not presently served by any communication space station 24, then the corresponding field in network location table 245 indicates such as represented by the term "open". If at step 604, the call signaling module 227 determines that the subscriber device 50 assigned to the subscriber is not presently served by any communication space station 24, the voice mail module 236 becomes the default destination subscriber device 50 to which call signaling is provided at step 612. If call signaling is provided to the voice mail module 236 at step 612, the call signaling module 227 negotiates compression algorithms and establishes communication channels at step 614 only to the originating device to relay voice real time communications between the voice mail module 236 and the originating device until the originating device is disconnected from the voice mail module 236. However, if the subscriber device 50 is served by a communication space station 24, such communication space station 24 becomes the destination device to which call signaling is provided at step 606.

At step 608, the call signaling module 227 determines whether the communication space station 24 is responding to the call signaling. In certain events, such as when the subscriber is already engaged in a telephone call or if the subscriber does not answer the inbound call, the communication space station 24 does not respond to the call signaling. In which case, the voice mail module 236 again becomes the default destination device to which call signaling is provided at step 612. If call signaling is provided to the voice mail module 236 at step 612, the call signaling module 227 negotiates compression algorithms and establishes communication channels at step 614 only to the originating device to relay voice real time communications between the voice mail module 236 and the originating device until the originating device is disconnected from the voice mail module 236. If the call signaling is responded to by the communication space station 24, the call

signaling module 227 at step 610 negotiates compression algorithms and establishes communication channels with both the communication space station 24 and with the originating device to relay voice or audio/video real time communications for the duration of the call.

For outbound calls, the communication space station 24 provides call signaling module 227 with a number that represents the intended destination. The number may be a 10 digit number routable on the Public Switched Telephone Network 42, a number identifying a person or station coupled to the multi-media Service Provider network 18, or a subscriber ID representing a subscriber to the system 10. The call signaling module 227 identifies the destination device first by determining whether the number represents a person or destination coupled to the multi-media Service Provider network 18, the Public Switched Telephone Network 42, or a subscriber. The call signaling module 227 refers to a directory within memory 235 that maps possible numbers to one of the three networks. It should be appreciated that a Public Switched Telephone Network routable telephone number may also represent a person or station coupled to the multi-media Service Provider network 18. As such, the directory within memory 235 may include a priority such that the call signaling module 227 attempts to establish call signaling utilizing multi-media Service Provider network 18 as a first priority and the Public Switched Telephone Network 42 as a second priority.

If the destination device is coupled to the multi-media Service Provider network 18, the number may be permanently assigned to a person or a station. However, the IP network address utilized by the person or station may change periodically. As such, the call signaling module 227 may query a remote directory server to determine the network address of the destination device or the network address of a proxy for the remote device. Call signaling is then provided to the destination device or the proxy. If the call signaling is responded to by the proxy or the remote device, the call signaling module 227 negotiates compression algorithms and establishes communication channels with both the originating communication space station 24 and with proxy or remote device for the relay of voice or audio/video real time communications for the duration of the call.

If the destination device is coupled to the Public Switched Telephone

Network 42, the destination device is the Public Switched Telephone Network interface 25 and call signaling is provided to the Public Switched Telephone Network interface 25. Again, if the call signaling is responded to by the Public Switched Telephone Network interface 25 (indicating that the call has been established on the Public Switched Telephone Network 42) the call signaling module negotiate compression algorithms and establish communication channels with the originating communication space station 24 for the relay of real time audio communications between the communication space station 24 and the Public Switched Telephone Network interface 25 for the duration of the call. If the destination device is a subscriber to the system 10, steps discussed above with respect to Figure 15 are applicable.

For both inbound and outbound calls, the relay of real time voice or audio/video communications is provided by a relay module 229 within the packet audio/video gateway 232. The relay module 229 relays sequences of real time transport protocol (RTP) frames that include compressed audio data and compressed video communications between each of the call participants and the conference mix module 237. The conference mix module 237 includes voice mixing circuits for receiving multiple voice streams to generate one or more conference mix voice streams. The conference mix module 237 provides the conference mix voice streams back to the relay module 229 for relay back to the conference session participants. It should be appreciated that it is undesirable to include the voice of a participant in the conference mix voice stream that be returned to such participant because echoes could occur. As such, a single conference call may require multiple conference mix voice streams - one for each participant that excludes such participant's own voice. As such, the conference mix module 237 may also generate a master mix signal that includes all participants that is passed to the recording module 39 which, in turn, stores a digital representation of the master mix signal in a voice recording file 37.

Voice Mail Module

The voice mail module 226 includes circuits for responding to the call signaling provided by the call signaling module 227, providing a sequence of RTP frames representing applicable audio prompts from compressed audio prompt files

233 to the relay module 229, receiving RTP frames from the relay module 229 representing the voice of the remote caller leaving a message for the subscriber, compressing the message into a digital audio file, and sending the digital audio file to the e-mail module 228 for storage in the e-mail files 247 for later retrieval by the subscriber.

E-mail Module

The e-mail module 228 maintains an e-mail account associated with each subscriber. The e-mail module 228 includes circuits for interfacing with a remote e-mail server. The e-mail module 228 logs onto an account associated with each subscriber, obtains new e-mail messages associated with the subscriber, and sends e-mail messages drafted by the subscriber to the remote server. The e-mail module 228 also maintains e-mail files 247 in the memory 235 that may include an address book and an inbox for each subscriber.

Web Server

The web server 230 comprises a communication space station management application 32, a multicast module 231, an address translation module 31, and a local content application 33. Examples of the multi media communication services provided to each subscriber by the web server 230 include: delivery of e-mail and voice mail messages (as e-mailed audio files) to the communication space station 24 at which the subscriber's subscriber device 50 is presently coupled; updating of the network location table 245 to assure proper routing of incoming voice and audio/video calls; delivery of data content provided by local data applications; proxy communication over multi-media Service Provider network 18 for delivery of data content provided by remote data application providers; delivery of a multicast messages directed to a subscriber to the particular communication space station 24 at which their subscriber device is presently coupled; and providing subscriber control of voice and audio/video conference calls through the packet gateway 232.

To provide communication services to each communication space station 24, the communication space station management application 32 processes certain scripts in response to events generated by a communication space station 24 and the packet gateway 232. In processing the scripts, the communication space station management application 32 manages subscriber communication data

stored in a memory 235 and provides operating instructions to each communication space station 24, the e-mail module 228, the multicast module 231, and the local content application 33. The communication space station management application 32 provides for the communication space station 24 to navigate, as a client, through a layered menu to select applicable services from the control unit 12. The communication space station application 32 maintains state information for each communication space station 24, such that each communication space station 24 may navigate through the layered menu independently of other communication space station 24 units.

The multicast module 231 provides IP multicast services to enable the communication space station management application 32 to simultaneously deliver selected communication services to multiple communication space stations 24, utilizing IP multicast protocols and without using excessive bandwidth on Local Area Network 22. The address translation module 31 provides address and port translation services to enable the web server 230 to provide each communication space station 24 with access to servers that provide remote data applications and are coupled to the multi-media Service Provider network 18 as an IP layer proxy and without using higher layer resources of the control unit 12. The local data content application 33 provides data content to each communication space station 24 in accordance with subscriber interaction through the communication space station 24.

In the exemplary embodiment, non-streaming media communication between the web server 230 and each communication space station 24 utilizes tagged data messages over a TCP/IP session between the web server 230 and a system client application 115 or an appliance module support application 117 (Figure 4) within the communication space station 24. Each message transferred between the web server 230 and the communication space station 24 comprises a data element and a tag identifying the significance of the data element. For example: if the data element comprises the text of an e-mail message, the tag would identify the data element as the text of an e-mail message; if the data element comprises an executable script that would provide for the communication space station 24 to perform a certain function, the tag would identify the data

element as executable script and may identify the significance of the script; and if the data element comprises display layout control information (e.g. a style sheet) defining how another date element (such as the text of the e-mail) should be displayed on a display screen, the tag would identify the data element as a style sheet.

Streaming media communications between the web server 230 (such as multi-cast streaming media messages provided by the IP multicast module 231 or streaming media content provided by the address translation module 31 or the local data application 33 and the client application 115 or the appliance module support application 117 utilize a sequence of RTP frames that include compressed media data and are sent utilizing UDP/IP channels.

Communication Space Station

Figure 3 illustrates a perspective view of a communication space station 24. The communication space station 24 includes a platform unit 52 that operatively couples to the control unit 12 via either a wireless communication link between a platform unit network circuit 96 and the wireless Local Area Network 22 or a direct network connection 23 between the platform unit 52 and the backbone network of the wireless Local Area Network 22.

A plurality of subscriber interface modules 54, 60a, 60b, and 11 may be coupled to the platform unit 52. The platform unit 52 includes a subscriber interface docking platform 64 for coupling and optionally supporting one of a plurality of modular subscriber interface units 60a or 60b to the platform unit 52. The modular subscriber interface unit 60a may include a plurality of buttons 68 in an arrangement similar to a typical telephone key pad to provide for subscriber input in a manner similar to that of a traditional telephone handset. The modular subscriber interface 60b may include a touch panel 72 to provide for subscriber input through virtual buttons visible thereon.

The platform unit 52 further includes a subscriber interface docking platform 74 which couples to a subscriber interface module 54. The subscriber interface module 54 may include subscriber interface buttons configured for enhancing subscriber messaging through the communication space station 24 such as a voice message control 76 for single button access to voice message files, an e-mail

control 78 for single button access to subscriber e-mail messages, and a print control 80 for single button initiation of the printing of an e-mail message.

The platform unit 52 further includes a docking bay 62a into which a modular docking interface 58 may be secured and operatively coupled to the platform unit 52. The modular docking interface 58 supports one of a plurality of modular subscriber devices 50 within a subscriber device interface bay 66 and provides for operatively coupling the modular subscriber device 50 to the platform unit 52. Exemplary configurations for the modular subscriber device 50 include a subscriber data assistant 86, a subscriber wide area network communication device 88, and the wireless LAN voice handset 26, each of which is discussed in more detail herein. The platform unit 52 also includes docking bay 61 into which a modular video camera 11 may be coupled to the communication space station 24. The platform unit 52 also includes appliance docking bays 62b and 62c into which a selected appliance module 30a, 30b, or 30c may be operatively coupled to the platform unit 52.

While operatively coupled to the platform unit 52, the subscriber device 50, the video camera 11, and the selected appliance module(s) 30a, 30b, 30c become an integral part of the subscriber interface of the communication space station 24. The module video camera 11 provides a video image for use by the communication space station 24 when participating in a video conference call. A liquid crystal graphic display on the subscriber device 50 and/or the appliance modules 30a, 30b, 30c may function to display multi-media communication management information under control of the platform unit 52 and the control unit 12. Programmable subscriber controls 92 positioned adjacent to the subscriber device 50 may be configured to activate platform unit 52 and control unit 12 functions in accordance with the contents of the graphic display 90 adjacent to the controls 92. Subscriber controls on each of the selected appliance modules 30a, 30b, 30c may activate platform unit 52 and control unit 12 functions to control the appliance modules 30a, 30b, 30c.

The platform unit 52 may further include one or more of the following elements: a handset 98 similar to a traditional telephone handset to provide a subscriber voice interface, a speaker 100 and a microphone 102 to provide a

hands-free subscriber voice interface, a modular battery pack 70 (which fits within a battery pack bay that is not shown) for operating power when the communication space station 24 is uncoupled from a line voltage, cell button 104 for single button selection of certain functions such as a wide area network communication function, and help button 106 for single button selection of a help function.

Figure 4 shows a block diagram of the communication space station 24. The platform unit 52 includes an application controller 112 coupled to a local bus 116 that interconnects a application controller 112 with a plurality of peripheral circuits that include a wireless module 94, a power management controller 120, a communication controller 122, a key switch controller 126, a touch panel controller 128, and a voice communication system 130. The wireless module 94 operatively couples the platform unit 52 with the control unit 12 over the wireless LAN 22 (both of Figure 1). The application controller 112 includes appropriate drivers for operation of the wireless module 94. The power management controller 120 selectively receives input power from the battery pack 70 or external line voltage 134. The power management controller 120 includes appropriate circuits for converting the input power voltage to appropriate operating power required by each component of the communication space station 24. Additionally, the power management controller 120 includes appropriate circuits for managing charging of the battery pack 70 when the platform unit 52 is coupled to the line voltage 134 and generating appropriate power for operating and/or charging the modular docking interface 58 and the modular subscriber device 50 when coupled to the platform unit 52.

The communication controller 122 operatively couples the application controller 112 to the modular docking interface 58 (and the modular subscriber device 50), the video camera 11, and each of the appliance modules 30a, 30b, 30c, such that the platform 52 can exchange data with each of such devices. In the exemplary embodiment, the communication controller 122 is a serial communication controller that enables the serial exchange of data with a compatible serial communication controller within the modular subscriber device 50 over a physical medium. An exemplary controller could be a USB hub or an Ethernet hub. Exemplary physical mediums could include hardwired contacts, an

infrared transmission, and RF transmission, however other controllers and physical mediums are envisioned and the selection of a physical medium is not critical to this invention.

The key switch (e.g. button) controller 126 is coupled to: a connector 136a which in turn is coupled to a mating connector on the modular subscriber interface unit 60a (Figure 3) for interconnecting the buttons 68 to the key switch controller 126; a connector 136b which in turn is coupled to a mating connector 142 on the function specific module 54 for interconnecting the buttons 76 and 86 to the key switch controller 126; the cell button 104; and the help button 106. The key switch controller 126 may drive row and column signals to the various buttons and, upon detecting a short between a row and a column (e.g. button activation) reports the button activation to the application controller 112 over the bus 116. Again, the application controller 112 includes appropriate drivers for operating the key switch controller 126.

The touch panel controller 128 is coupled to a connector 144 which in turn is coupled to a mating connector on the modular subscriber interface unit 60b (Figure 3) for interconnecting the touch panel 72 to the touch panel controller 128. In the exemplary embodiment, the touch panel controller 128 may include a separate display control circuit compatible with the resolution and color depth of the display component of the touch panel display 72 and a separate touch panel control circuit for detecting subscriber contact with the touch panel display 72. The application controller 112 includes appropriate systems for driving the contents of the touch panel display 72 through the touch panel controller 128.

The voice communication system 130 generates analog voice signals for driving the speaker 100 (or the speaker in the handset 98 of Figure 3) and detects input from the microphone 102 (or the microphone in the handset 98) under the control the application controller 112.

The application controller 112 executes a packet voice/video communication client 113, a client application 115, and an appliance module support application 117. The packet voice/video communication client 113 provides for setting up UDP/IP channels for RTP packet voice and RTP packet video communications with the packet gateway 232 (Figure 2) within the control unit 12. The packet

audio/video communication client 113 also compresses video images from the video camera into a sequence of RTP frames for sending to the packet gateway 232, compresses voice signals from the voice communication circuit 130 into sequences of RTP frames for sending to the packet gateway 232 and decompresses RTP frames of video images and audio signals received from the packet gateway 232 for driving the voice communication circuit 130 and for displaying a video image on a display. In the exemplary embodiment, the packet vocie/video communication client 113 may be one of the commercially available clients utilizing established protocols such as the International Telephone Union (ITU) H.323 protocols, The Internet Engineering Task Force (IETF) Session Initiation Protocols, or other protocols useful for signaling and establishing a real time streaming media session with the packet gateway 232.

The client application 115 operates as a client to the web server application 230 (Figure 3) within the control unit 12. The client application 115 provides for the application controller 112 to: generate an image on the touch panel display 72 or on the display 90 on the subscriber device 50 in accordance with display content and a style sheet received from the control unit 12; output an audio stream file received from the control unit 12 through the voice system 130; execute processing steps in accordance with instructions received from the control unit 12; provide messages indicating subscriber actions (such as subscriber activation of the cell button 104, the help button 106, a touch panel virtual button, or any other button on the communication space station 24) to the web server application 230; activate the packet voice/video client 113 to set up a real time voice/video session with the packet gateway 232 (Figure 2); identifying the modular configuration or subscriber interface configuration of the communication space station 24 and reporting the configuration to the control unit 12; and reporting the coupling of (and decoupling of) a subscriber device 50 and/or modules to the platform 52 of the communication space station 24 to the control unit 12.

The appliance module support application 117 operates as a client to the web server application 230 (Figure 3) within the control unit 12 to provide for the control unit 12 to support appliance modules 30a, 30b, and 30c. In the case of appliance module 30a, the appliance module support application 117 provides for:

the subscriber to operate channel select buttons on the appliance module 30a to select a streaming audio/video channel that includes data content (such as news, weather, finance) desired by the subscriber; and the controller 12 to send streaming audio/video media in accordance with the subscriber selection for display on display 488 and output by the speaker 490. In the case of appliance module 30b, the appliance module support application 117 provides for the control unit 12 to provide stock ticker data for output on the long narrow display screen 450. In the case of appliance module 30c, the appliance module support application 117 provides for reporting of subscriber activation of buttons on the appliance module 30c to the control unit 12 and receipt of display screens for display to the operator on the display screen 476.

Figure 14 illustrates in flow diagram form, the operation of the appliance module support application 117. At step 550, the appliance module support application 117 establishes communications with an appliance module 30a-c utilizing the communication controller 122 once the appliance module 30a-c is docked to the docking bay 62b or 62c. At step 552, the appliance module support application 117 obtains content application logon data. More specifically, this step may include reading a network address of either a local content application or a remote content application provider coupled to the multi-media Service Provider network 18 from a memory as well as a logon id, password, and other data that may be useful initiating a session with the content application. Alternatively, this step may include obtaining all such data from the appliance module 30a-c utilizing the communication controller 122.

At step 554, the appliance module support application 117 uses the content application logon data from step 552 to establish a session with the content application. Thereafter, the sub steps of step 556 represent operation of the appliance module support application 117 during the session. In sub-step 558, the appliance module support application 117 receives signals from the appliance module 30a-c indicating subscriber operation of buttons on the appliance module 30a-c (or other subscriber controls). At step 560, the appliance module support application 117 extracts the data from the received signals to identify the indication of subscriber operation of the button and builds a frame of data that includes

message schema comprising a data element representing the subscriber activation and a tag identifying the data element. At step 562, the appliance module support application 117 sends the frame to the content application utilizing a communication protocol compatible with Local Area Network 22 and the content application.

Sub-steps 564 - 568 represent interfacing data received from the content application to the appliance module. At step 564, the appliance module support application 117 receives frames of data from the content application. The frames of data may be RTP frames representing streaming audio/video data or may be a message schema that includes tagged data elements. If at step 556, the frames are determined to be RTP frames, at step 572, the appliance module support application 117 chronologically sequences the compressed streaming audio or audio/video data from the received frames. At step 574, the appliance module support application 117 provides a digital signal representing the sequenced streaming media data to the appliance module 30a-c utilizing the communication circuit 122. Alternatively, if at step 556 the frames are determined to be a message schema, at step 558, the appliance module support application 117 extracts a data element value from the message schema along with identifying the data element providing operating instructions (that may include both the data element value and the identify of the data element) to the appliance module. An example would include operating instruction to refresh a graphic image on an appliance module display screen.

Subscriber Data Assistant

Figure 5 illustrates an exemplary structure of a subscriber data assistant 86 which includes a subscriber data assistant controller 160 interconnected to a plurality of peripheral controllers by an internal bus 162. Because of the small size and the portability of the subscriber data assistant 86, the touch panel 90 provides the primary subscriber interface. The touch panel 90 is controlled by a display controller 164 and a touch panel controller 166. The display controller 164 drives the liquid crystal display of touch panel 90 using signals compatible with the resolution and color depth of the display 90. The touch panel controller 166 detects user activation of the touch panel 90. The subscriber data assistant controller 160

operates appropriate drivers 176 for controlling operation of the touch panel controller 166 and the display controller 164.

A communication controller 168 is also coupled to the bus 162 and operates under control of the subscriber data assistant controller 160. The communication controller 168 is a serial communication controller that is compatible with the communication circuit 122 of the platform unit 52 (both of Figure 4) such that data communication may occur between the platform unit 52 and the subscriber data assistant 86 when the subscriber data assistant 86 is operatively coupled to the platform unit 52.

A power management circuit 170 selectively receives input power from a battery pack 172 or from the power management circuit 120 in the platform unit 52. The power management circuit 170 includes appropriate circuits for converting the input power voltage to appropriate operating power required by each component of the subscriber data assistant 86. Additionally, the power management circuit 170 includes appropriate circuits for managing charging of the battery pack 172 when the subscriber data assistant is coupled to the platform unit 52.

The subscriber data assistant controller 160 also operates a communication space station client application 174 to display multi-media communication management information under control the platform unit 52 when coupled to the platform unit 52. The communication space station client application 174 receives messages from the platform unit 52 in the form of tagged messages. After receipt of the tagged messages, the communication space station client application 174 builds a display document to display the communication management information represented by tagged content messages in accordance with a style sheet that is compatible with the size, resolution, and color depth of the touch panel display 90. The display document is then displayed on the touch panel display 90.

It should be appreciated that in additional to operating the drivers 176 and the communication space station client application 174, the subscriber data assistant controller 160 may optionally operate any of the software applications that are commercially available for portable data assistants (PDAs) which may include address book management software, calendar management software, and games. While operation of such PDA applications may be useful to the subscriber, it is not

critical to the operation of the present invention.

Subscriber Wide Area Network Communication Device

Figure 6 illustrates in block diagram form wide area network communication device 88 that includes a wide area network controller 180 operating a Communication Space Station application 174', the subscriber contact directory application 178, a wireless communication application 194, and applicable drivers 196 for a plurality of peripheral controllers. The wide area network controller 180 is interconnected to the plurality of peripheral controllers by an internal bus 186. The peripheral controllers include a wide area network RF circuit 182, a voice system 197, a display controller 184, a touch panel controller 185, a key switch controller 193, a communication controller 188, and a power management system 190.

The wide area network RF circuit 182 may be a circuit for transmitting and receiving signals from a wide area network service provider's medium under control of the wireless communication application 194. Exemplary wide area network service provider mediums include an analog or digital cellular or PCS telephone RF system.

The key switch controller 193 is coupled to the control buttons 195. The key switch controller 193 drives row and column signals to the control buttons 195 and, upon detecting a short between a row and a column indicating button activation, reports the activation to the wide area network controller 180. The control buttons 195 may be used by a subscriber for operating the wide area network communication device 88 when uncoupled form the platform unit 52.

The voice system 197 includes a speaker and a microphone. Under control of the wireless communication application 194, the voice system 197 may provide a subscriber voice interface for an audio session with a remote device over the wide area network service provider's medium. The display controller 184 drives the touch panel 90 using signals compatible with the resolution and color depth of the touch panel display 90. The touch panel 90 may optionally be a touch panel display 90 and the touch panel controller 185 detects user activation of the touch panel 90. The communication controller 188 may be a serial communication controller compatible with the communication controller 122 in the platform unit 52 such that data communication may occur between the platform unit 52 and the

wide area network communication device 88 when the wide area network communication device is operatively coupled to the platform unit 52. The power management controller 190 operating with a battery pack 192, both of which may operate in a similar manner to the power management controller 170, and the battery pack 172 discussed with reference to Figure 5.

Similar to the subscriber data assistant 86 (Figure 5), when the wide area network communication device 88 is coupled to the platform unit 52, the Communication Space Station application 174' provides for displaying multi-media communication management information under control the platform unit 52 and provides for multi-media communication directly between the platform unit and the wide area network service provider medium.

In addition the Communication Space Station application 174' may receive messages from the platform unit 52 which may be multi-media communication messages for communication over the wide area network service provider medium. Each message includes a tag that identifies the contents of the message. After receipt of a tagged message, the Communication Space Station application 174' may identify whether the message is for communication with the wide area network service provider medium or whether it is multi-media communication management information for display.

When the message is for communication with the wide area network service provider medium, the Communication Space Station application 174' reformats the message to a format compatible with wide area network service provider medium transmission standards and transmit the message using the wide area network RF circuit 182. The wide area network communication device 88 may also receive signals from the wide area network service provider medium via the wide area network RF circuit 182. When received, the Communication Space Station application 174' reformats the messages into a plurality of tagged messages for communication to the platform unit 52 and sends the tagged messages to the platform unit 52 via the communication controller 188.

Wireless Voice Handsets

Figure 7 shows a block diagram of an exemplary wireless voice handset 26. The wireless voice handset 26 includes a network circuit 278 and a wireless voice

handset controller 250 that operates a Communication Space Station application 174", the subscriber contact directory application 178, a LAN communication application 252, and applicable drivers 254 for each of a plurality of peripheral controllers. The wireless voice handset controller 250 is interconnected by a bus 276 to the plurality of peripheral controllers which include a module controller 258, a display driver 260, a touch panel driver 261, a key switch controller 264, and a power management circuit 270.

The module controller 258 operatively couples the network circuit 278 to the controller 250 such that the wireless voice handset 26 may communicate with the control unit 12 over the wireless LAN 22 (both of Figure 1). In the exemplary embodiment, the module controller 258 may be a PCMCIA controller circuit and the network circuit 278 is configured as a PCMCIA card that coupled to the module controller 258 through a PCMCIA connector 272. The LAN communication application 252 operates the network circuit 278 for communicating with the control unit 12 using appropriate wireless signaling protocols.

The key switch controller 264 is coupled to the control buttons 266. The key switch controller 264 drives row and column signals to the control buttons 266 and, upon detecting a short between a row and a column indicating button activation, reports the activation to the wireless voice handset controller 250. The control buttons may be used by a subscriber for operating the wireless voice handset 26 when uncoupled form the platform unit 52.

The display controller 260 drives the display 90 (optionally a touch panel display 90) using signals compatible with the resolution and color depth of the display 90. The touch panel controller 261 detects user activation of the touch panel display 90. The power management controller 270 operates in conjunction with a battery pack 268, both of which may operate in a similar manner to the power management controller 170, and the battery pack 172 discussed with reference to Figure 5.

When the wireless voice handset 26 is coupled to the platform unit 52, the Communication Space Station application 174" provides for displaying multi-media communication management information under control the platform unit 52. Additionally, the Communication Space Station application 174" may receive multi-

media communication management information content messages and control messages directly from the control unit 12 via the wireless network 22. After receipt of the tagged messages from either the platform unit 52 or the control unit 12, the Communication Space Station application 174" builds a document to display the communication management information represented by the tagged content messages in accordance with display layout control messages that are compatible with the size, resolution, and color depth of the touch panel display 90. The display document is then displayed on the touch panel display 90.

Stock Ticker Appliance Module

Figure 9 illustrates in block diagram form a stock ticker appliance module 30b that includes a stock ticker appliance module control unit 442, a communication circuit 444, a memory (which may be embedded with the control unit) 446, a display driver 448, and a long narrow display useful the display of streaming stock ticker data.

The communication circuit 444, operating under control of the stock ticker appliance module control unit 442, utilizes communication protocols that are compatible with the communication controller 122 (Figure 4) such that the communication controller 122 may receive stock ticker data while secured to the docking bay 62c (Figure 4). The display driver 448, operating under control of the stock ticker appliance module control unit 442, reads a virtual representation of the display in the memory 446 and provides row and column signals for driving the display 450 to show a streaming stock ticker in accordance with a virtual representation of display content in the memory 446. The stock ticker appliance module control unit 442 includes circuits for operating the communication circuit 444 and the display driver 448 and for receiving the stock ticker data from the communication circuit 444 and writing a virtual representation of screen content of a streaming ticker to the memory 446. In operation, the stock ticker appliance module control unit 442 initiates communication with the communication space station 24 at start up and may identify either a local content application or a remote content application coupled to the multi-media service provider network 18 that provides stock ticker data. Thereafter, the stock ticker appliance module control unit 442 coordinates the receipt of stock ticker data from the communication space

station 24 utilizing the communication circuit 444 and the display of streaming stock ticker data utilizing the display driver circuit 448.

Time Billing Appliance Module

Figure 10 illustrates in block diagram form a time and billing appliance module 30c that includes a time and billing control unit 452, a communication circuit 454, a memory (which may be embedded with the control unit) 458, a display driver 460, a display 462, and a plurality of subscriber activated buttons 464 - 474. The communication circuit 454, operating under control of the time and billing control unit 452, utilizes communication protocols that are compatible with the communication controller 122 (Figure 4) such that the communication circuit may provide indications of subscriber activation of buttons 464 - 474 to the communication space station 24 and receive data for display on the display screen 462 from the communication space station 24 while secured to the docking bay 62b (Figure 4). The display driver 460, operating under control of the time and billing control unit 452, reads a virtual representation of the display in the memory 458 and provides row and column signals for driving the display 462 to show a graphic display of information to the subscriber in accordance with the virtual representation of display content in the memory 458. The control unit 452 includes a key switch control circuit 456 coupled to each of the buttons 464 - 474 for detecting subscriber activation of a button 464 - 474, circuits for operating the communication circuit 454, and circuits for operating the display driver 460.

In operation, the time and billing control unit 452 initiates communication with the communication space station 24 at start up and may identify either a local content application or a remote content application coupled to the service provider network 18 that provides time and billing services. Thereafter, the time and billing control unit 452 coordinates the receipt of time and billing data and the sending of indications of subscriber activation of the buttons from and to the communication space station 24 utilizing the communication circuit 454 and the display of the billing data utilizing the display driver circuit 462. The buttons 464 - 474 are each labels with the function that, when activated, be performed by the time and billing control unit 452 or the local or remote content application. For example, activation of the scroll up button 472 or scroll down button 474 initiates the time and billing

control unit 452 to scroll (up or down respectively) a highlight bar 476 on a list of projects on the display 462. If the time and billing control unit 452 stores an entire list of projects locally, the scrolling may be performed by the control unit 452. Alternatively, if the display 462 only displays an image provided by the content application, the scrolling would be performed by the content application and a new display image would be provided to the control unit for display. Activation of the start time button 464 initiates the time and billing control unit 452 sending an indication of such activation to the content application so that the content application can begin accruing time to the project that was highlighted on the display 462 at the time of button 464 activation. Activation of the end time button 466 initiates the time and billing control unit 452 sending an indication of such activation to the content application so that the content application stops accruing time to a project. Activation of the record button 468 initiates the time and billing control unit 452 sending an indication of such activation to the local content application so that the local content application can activate the recording module 39 in the packet gateway 232 to begin recording a voice (or audio/video) session. Activation of the stop record button initiates the time and billing control unit 452 sending an indication of such activation to the local content application to deactivate the recording module 39 and stop recording a voice or audio/video session.

Selectable Media Channel Appliance Module

Figure 11 illustrates in block diagram form a selectable media channel appliance module 30a is shown. The appliance module includes a selectable media channel control unit 480, a communication circuit 482, a memory (which may be embedded with the control unit) 492, a display driver 484, a display 488, an audio driver 486, a speaker 490, a plurality of subscriber activated buttons 496 - 499, and a subscriber activated volume control 500.

The communication circuit 482, operating under control of the selectable media channel control unit 480, utilizes communication protocols that are compatible with the communication circuit 122 (Figure 4) such that the communication circuit may provide indications of subscriber activation of buttons 496 - 499 and activation of volume control 500 to the communication space station

24 and receive streaming audio/video programming for display on the display screen 488 and for output by the speaker 490 from the communication space station 24 while secured to the docking bay 62b (Figure 4).

The display driver 484 obtains a digital video signal from a real time media decompression circuit 494 and provides row and column signals for driving the display 488 to show a full motion video of the programming. The audio driver 486 obtains digital audio data from the real time media decompression circuit 494 and provides an analog signal for driving the speaker 490 to provide audio coinciding with the video programming. The selectable media channel control unit 480 includes a circuit for operating the communication circuit 454, a circuit for operating the display driver 460, and a key switch control circuit 495 coupled to each of the buttons 496 - 499 and to the volume control 500 for detecting subscriber activation of such buttons and volume control.

In operation, the selectable media channel control unit 480 initiates communication with the communication space station 24 at start up and may identify either a local content application or a remote content application coupled to the service provider network 18 that provides audio/video programming such as news, weather, or other information programs. Thereafter, the selectable media channel control unit 480 coordinates the receipt of real time streaming audio/video programming and the sending of indications of subscriber activation of the buttons 496 - 499 and the volume control 500 from and to the communication space station 24 utilizing the communication circuit 482 and coordinates the display of and the audio output of the real time streaming media audio/video programming utilizing the display driver circuit 484 and the audio driver circuit 486.

The buttons 496 - 499 are each labeled with program content that, when activated by the subscriber, initiate the selectable media channel control unit 480 sending an indication of such button activation to the content application to initiate the feed of real time audio/video data that corresponds with the selected program content. For example, activation of the weather button 496 initiate the selectable media channel control unit 480 sending an indication of such button activation to the content application and the content application begin sending streaming audio/video data that provides weather information to the subscriber. Similarly,

button 497 provides news information to the subscriber.

Communication Space Station Management Application

The flowcharts of Figures 12a through 12j represent exemplary processing steps performed by the communication space station management application 32 to provide control of communication services to a communication space station 24.

Figure 12a in conjunction with Figure 2 illustrates the operation of the communication space station management application 32 upon receiving an open session request on a predetermined port from a communication space station 24 that has just been operatively coupled to the Local Area Network 22, obtained a network address from the network address server 220, and is ready to operate as a client to the communication space station management application 32. At step 300 communication space station management application 32 receives the open session request and establishes a TCP/IP session with the communication space station 24 at step 302. The communication space station management application 32 sends a start up script to the communication space station 24 at step 304, which start up script includes instructions that, when executed by the client application 115, provide for the communication space station 24 to detect its subscriber interface configuration (e.g. whether the communication space station 24 includes a display screen and what capabilities such as video capabilities and graphic resolution capabilities the display screen may have) and to report its subscriber interface configuration back to the communication space station management application 32.

The communication space station management application 32 at step 306 receives the subscriber interface configuration of the communication space station 24 from the communication space station 24 and writes at step 308 an indication of the subscriber interface configuration of the communication space station 24 to a subscriber interface table 239 in the memory 235. The communication space station management application 32 retrieves a main menu display style sheet from a selection of style sheets 241 stored in the memory 235 at step 310, which main menu display style sheet can be a style sheet that corresponds to the subscriber interface configuration of the communication space station 24. The communication space station management application 32 provides main menu display content and

the style sheet to the communication space station 24 at step 312 and updates at step 314 a communication space station state table 243 in the memory 235 to indicate that the communication space station 24 is in a main menu state. It should be appreciated that the main menu content provided to the communication space station 24 is independent of the subscriber interface, however, the style sheet provided to the communication space station 24 is dependent on the subscriber interface. For example, turning to Figure 16a which represents display of a main menu on a subscriber device 50 in the modular docking interface 58 the content of the main menu display includes a title of main menu and choices of view e-mail, voice mail, and multi cast paging. The style sheet corresponding to a subscriber interface that includes a subscriber device 50 provides for the content to be graphically displayed with the title at the top and each menu choice to be displayed adjacent a button 92 on the modular docking interface 58. Alternatively, turning to Figure 16b which represents display of a main menu on a display 72 that is coupled to a communication space station interface 64 (Figure 3), the content of the main menu display again includes a title of main menu and the choices of view e-mail, voice mail, and multi cast paging. However, the style sheet that corresponds to a subscriber interface that includes a display 72 that is coupled to a communication space station interface 64 provides for the content to be graphically displayed with the title at the top and each choice to be displayed in a vertical list with an adjacent numeral for selection using the keypad 68 (Figure 3). The examples shown in Figures 16a and 16b are for illustrative purposes only. Other subscriber interface configurations that include non-graphic displays, bit mapped multi line text displays, or 7 element single or multi-line text displays may utilize different style sheets for displaying all or a portion of the main menu content.

Figure 12b illustrates in flow diagram form the steps performed by the communication space station management application 32 upon receiving an indication at step 316 that a subscriber device 50 has been coupled to a communication space station 24.The communication space station management application 32 at step 318 sends a device ID extraction script to the communication space station 24, which includes instructions that, when executed by the client application 115, provide for the communication space station 24 to interrogate the

subscriber device 50 to determine its device identification (e.g. an identification of which subscriber to which the device has been assigned) and to report the device identification back to the communication space station management application 230. The communication space station management application 32 at step 320 receives the device identification back from the communication space station 24 and associates at step 322 the device ID with the communication space station 24 in the network location table 245 in the memory 235. As discussed previously, the packet gateway 232 utilizes the network location table 245 for routing incoming telephone calls to the particular communication space station 24 at which a subscriber's subscriber device 50 is then currently coupled. It should be appreciated that this step 322 provides for the network location table 245 to properly indicate association between a communication space station 24 and the subscriber device 50 that is served thereby.

Because the style sheet selected for display of content on the communication space station 24 is dependent on the subscriber interface configuration of the communication space station 24 as determined by the subscriber interface table 239, the table should be updated when the subscriber interface configuration changes. Coupling a subscriber device 50 to a communication space station 24 changes the subscriber interface because the display of the subscriber device 50 becomes a display for the communication space station 24. As such, step 324 represents updating the subscriber interface configuration of the communication space station 24 in the subscriber interface table 239.

The communication space station management application 32 at step 326 retrieves a main menu display style sheet that is applicable to the new subscriber interface configuration from the selection of style sheets 241 in the memory 235 and provides at step 238 the main menu display contend and the style sheet to the communication space station 24. The communication space station management application 32 at step 330 updates the communication space station state table 243 to assure that it represents that the communication space station 24 is in the main menu state. The flow chart of Figure 12c represents steps performed by the communication space station management application 32 upon receiving an

indication at step 322 that a subscriber device 50 has been removed from a communication space station 24. The network location table is updated upon removal of a subscriber device form a communication space station 24 because the packet gateway 232 utilizes the network location table 245 for routing incoming telephone calls to the particular communication space station 24 at which a subscriber's subscriber device 50 is then currently coupled. The communication space station management application 32 at step 334 disassociates the subscriber device 50 from the communication space station 24 in the network location table 245. The communication space station management application 32 at step 336 updates the subscriber interface configuration table 239 because the display on the subscriber device 50 is no longer part of the subscriber interface of the communication space station 24 after the subscriber device 50 is removed.

The communication space station management application 32 at step 338 retrieves a main menu display style sheet that is applicable to the subscriber interface configuration without the subscriber device 50 from the selection of style sheets 241 in the memory 235 and provides at step 340 the main menu display content and the style sheet to the communication space station 24. The communication space station management application 32 at step 342 updates the communication space station state table 243 to assure that it represents that the communication space station 24 is in the main menu state.

The flowchart of Figure 12d represents steps performed by the communication space station management application 32 upon receiving a subscriber indication of a command to view subscriber e-mail messages. The means by which the communication space station 24 may detect such a subscriber indication is dependent on the subscriber interface configuration of the communication space station 24. For example, if the subscriber interface includes the e-mail button 78 (Figure 3), detection of button 78 activation would be a subscriber indication of a command to view subscriber e-mail messages. Similarly, subscriber activation of the e-mail menu choice on the main menu either by touch panel activation or by activation of a button associated with the menu choice (either or both of which may be applicable dependent on the subscriber interface configuration) would be a subscriber indication of a command to view subscriber e-

mail messages. The communication space station management application 32 receives the subscriber indication of a command view subscriber e-mail messages at step 344.

The communication space station management application 32 at step 346 instructs the e-mail module 228 to logon onto an e-mail server (which may be a remote e-mail server coupled to the multi-media Service Provider network 18) and to receive new e-mail messages associated with the subscriber's account. The communication space station management application 32 at step 348 writes the new e-mail messages to the subscriber inbox in the e-mail files 247 in the memory 235. In an embodiment wherein the remote e-mail server maintains subscriber inbox information, steps 346 and 348 may be viewed as synchronizing the e-mail messages between the remote server and the e-mail files 247. It should also be appreciated that the e-mail module 228 may periodically retrieve new e-mail messages and write to the subscriber inbox independently of whether the subscriber has activated an e-mail control. As such, the inbox already include new messages and steps 348 and 348 may not need to be performed in response to event 344.

The communication space station management application 32 at step 350 retrieves inbox content from the e-mail files 247 and retrieves at step 352 an inbox style sheet that is applicable to the subscriber interface from the style sheets 241 in the memory 235. Because the subscriber's voice mails be sent to the subscriber's e-mail account as audio files, it is possible that he e-mail messages retrieved at step 346 include both text-based e-mails and e-mails from the voice mail server 226. The inbox style sheet provides for the display of the e-mail messages received from senders other than the voice mail server 226 to be displayed first (or on the top of the display) because the subscriber activated a command to view e-mail messages. The communication space station management application 32 at step 354 provides the inbox content and style sheet to the communication space station 24 and updates at step 356 the communication space station state table 243 to indicate that the communication space station 24 is in an e-mail state.

The flowchart of Figure 12e represents steps performed by the communication space station management application 32 receiving a subscriber

indication of a command to obtain voice mail messages. Again, the means by which the communication space station 24 may detect such a subscriber indication is dependent on the subscriber interface configuration of the communication space station 24. For example, if the subscriber interface includes the voice mail button 76 (Figure 3), detection of button 76 activation would be a subscriber indication of a command to obtain voice mail messages. Similarly, subscriber activation of the voice mail menu choice either by touch panel activation or by activation of a button associated with the menu choice would be a subscriber indication of a command to obtain voice mail messages. The communication space station management application 230 at step 258 receives the subscriber indication of a command obtain voice mail messages.

The communication space station management application 32 at step 360 instructs the e-mail module 228 to logon onto the e-mail server and to receive new e-mail messages associated with the subscribers account because voice mail messages be sent as audio files form the voice mail server 226 to the subscriber's e-mail account. The communication space station management application 32 at step 362 writes the new e-mail messages to the subscriber inbox in the e-mail files 247 in the memory 235. The communication space station management application 32 at step 364 retrieves inbox content from the e-mail files 247 and represents retrieves an voice mail style sheet that is applicable to the subscriber interface from the style sheets 241 in the memory 235 at step 366. Because the e-mail messages that include voice mail audio files from the voice mail server 226 may be intermixed with e-mail messages from other senders, the voice mail style sheet provides for only the display of the voice mail messages received from the voice mail server 226. The communication space station management application 32 at step 368 provides the inbox content and the voice mail style sheet to the communication space station 24 and updates at step 370 the communication space station state table 243 to indicate that the communication space station 24 is in a voice mail state.

The flowchart of Figure 12f represents steps performed by the communication space station management application 32 upon receiving a subscriber indication of a command to initiate a multicast paging message. The

communication space station 24 may detect such a subscriber indication by various means, such as touch panel activation of button activation of a menu selection on the main menu, dependent on the subscriber interface configuration of the communication space station 24. At step 372, the communication space station management application 230 receives the subscriber indication of a command to initiate a multicast paging message and at step 374 retrieves the subscriber's address book content 249 from the e-mail files 247. As shown in Figure 8b, the address book content 249 may comprise a plurality of records with each record including a group identification name and identification of each subscriber in such group, and, if the group identifies a single person, contact information for the person. The communication space station management application 32 at step 376 retrieves a select paging group style sheet that corresponds to the subscriber interface of the communication space station 24 and at step 378 provides both the address book content and the select paging group style sheet to the communication space station 24. The communication space station management application 32 at step 380 updates the communication space station state table 243 to indicated that the communication space station 24 is in the select paging group state.

Figure 16c represents an exemplary display of the select paging group content utilizing a style sheet that may be applicable for use on a display 72 wherein the subscriber may use buttons or touch panel activation may be utilized to select one or more paging groups to include in the multicast page. It should be appreciated that some paging groups may include only a single name such that individuals may be selected to include in the multicast page. Because the list of groups included in the paging group content may be larger than can be displayed on the display 72, the style sheet may provide for only a portion of the content to be displayed along with touch activated scroll controls for display of the remainder of the content. The style sheet may further include touch activated controls to return to the main menu and to start the multicast message.

Figure 16d represents an exemplary display of the select paging group content utilizing a style sheet that may be applicable for display of the content on a display of a subscriber device 50 coupled in the modular docking interface 58.

Because subscriber selection is to be by activation of buttons 92, the style sheet provides for the content to be displayed with the groups on the left side for selection by buttons 92 on the left side of the modular docking interface 58 and for indicators to label the function of the buttons 92 on the right side of the modular docking interface 58 such as scroll up, scroll down, start message, and return to main menu.

The flowchart of Figure 12g represents steps performed by the communication space station management application 32 upon receiving a subscriber indication of a command to start the multicast paging message. The communication space station management application 32 at step 384 receives such a subscriber indication along with identification of the subscriber selected multicast groups to include in a multicast recipient list. Steps 388 through 394 represents steps that are performed by the communication space station management application 32 for each recipient. Such steps may be performed in sequence or in parallel. For purposes of illustration, the steps are shown performed in sequence. The communication space station management application 32 at step 388 identifies the subscriber device 50 that is associated with the recipient and determines if the subscriber device is then currently coupled to a communication space station 24. If yes, at step 390 The communication space station management application 32 invites such communication space station 24 to the multicast session group. However, if the subscriber device 50 associated with the recipient is not coupled to a communication space station 24 where the subscriber may receive the multicast, then at step 404 the recipient is added to an e-mail list.

Following step 390, The communication space station management application 32 at step 392 determines whether the communication space station 24 joined the multicast session group. If the communication space station 24 is operating a voice session, it would be inappropriate to interrupt the voice session with a multicast page for the subscriber. As such, it is envisioned that the communication space station 24 may, when in certain operational states, not join the multicast session group. In which case, the recipient is added to the e-mail list at step 406. After the recipient is either added to the e-mail list at step 405 or the communication space station 24 joined the multicast session group at step 392, the

communication space station management application 32 at step 394 determines if steps 388 though 392 must be performed for additional recipients. If not, at step 396 The communication space station management application 32 establishes a RTP channel with the communication space station 24 that initiated the multicast paging message and at step 398 instructs the communication space station management to prompt the subscriber to begin the multicast paging message. The communication space station management application 32 at step 400 multicasts the message to the session group utilizing the multicast module 231 and at step 402 formats the multicast message into an audio file and sending the audio file by e-mail to each recipient that was added to the e-mail list at either step 404 or 406.

The flowchart of Figure 12h represents steps performed by the communication space station management 32 upon receiving a subscriber indication of a command to initiate an audio or an audio/video conference call from a communication space station 24. The communication space station may detect such a subscriber indication by various means, such as by subscriber activation of the conference call control 502 on the touch panel 72 of Figure 16b or by activation of a button 92 corresponding to the conference call menu selection on the display screen 50 of Figure 16a. The communication space station management application 32 at step 404 receives such an indication from a communication space station 24, at step 406 retrieves the subscriber's address book content 249 from the e-mail files 247 and at step 408 retrieves a "select conference session participants" that corresponds to the subscriber interface of the communication space station 24 from the style sheets 241 in the memory 235. The communication space station management application 32 at step 410 provides both the address book content and the style sheet to the communication space station 24 for display. The communication space station management application 32 at step 412 receives subscriber selection of participants for the conference call. Figure 16e represents an exemplary display of the address book for selection of conference call participants on the touch panel 72. The communication space station 24 may detect subscriber activation of the touch panel 72 to "highlight" conference call participants and indicate that selection is complete by activating a finished control 512. Upon activation of the finish control, the communication space station 24

provides the subscriber selection of participants to the communication space station management 32. The communication space station management application 32 at step 414 provides the conference session participant list to the packet audio/video gateway 232 and at step 416 updates the state of the communication space station 24 to a conference call state. After receiving the session participant list from the communication space station management 230, the packet gateway 232, or more specifically the call signaling module 227 (Figure 2) establishes applicable audio and video communication channels with those communication space stations 24 that are serving subscriber devices associated with the participants in accordance with the steps discussed above. With the communication channels open, the packet gateway 232 activates the conference mix module 237 to begin mixing the voice streams from each communication space station 24 participating in the call. The packet gateway 232 also reports the status of each participant to the communication space station management 32. More specifically, the status includes an indication of whether each session participant is connected to the conference or is inactive (not connected to the conference). The status may also indicate whether the participant has stopped providing an active audio stream (e.g. put their phone on mute) and may indicate whether the conference mixing module has suspended sending a conference mix to the participant (e.g. the packet gateway 232 has placed a particular participant on hold for a time period to so that others can converse without such participant hearing the conversation).

The flowchart of Figure 12i represents steps performed by the communication space station management application 32 upon receiving conference status content at step 418 from the packet gateway 232. The communication space station management application 32 at step 419 retrieves a "status" style sheet from the style sheets 241 stored in the memory 235 and at step 410 provides the status content and the style sheet to at least the initiating communication space station 24 and optionally, to other communication space stations 24 participating in the conference call. It should be appreciated that the steps for the flowchart of Figure 12i may be repeated several times during the duration of a conference call as the status of each participant changes.

Figure 16f represents an exemplary display of the status of each participant

on the touch panel 72. The display includes a vertical listing of each participant and an indication of the participant's status in a column 514. An "A" indicates that the participant is active (e.g. sending a non-mute audio stream and receiving a conference mix audio stream). An "I" indicates that the participant is not on the conference call. A "M" indicates that the participant has muted their telephone and is not sending an audio stream. An "H" indicates that the participant has been placed on hold by the initiating communication space station and is not receiving a conference mix.

The display also includes a video indication column 516. This column indicates which participants are not sending a video image signal to the packet voice/video gateway 232 (e.g. the "Φ" symbol). Because the subscriber may select which of the participants to view during a video conference, the video column 516 also indicate the subscribers selection of the video image to view if the subscriber activates the video control 520. In the exemplary display, the "*" symbol associated with Dave indicates that the subscriber would view the video image provided by Dave's communication space station 24 upon activating the video control 520. The subscriber may change such selection by utilizing the controls of the touch panel 72. Upon detecting activation of the video control, the communicating space station report the indication to the communication space station management application 230.

The display also includes a hold control 522. The initiating subscriber may indicate his or her desire to place a participant(s) on hold status by highlighting the participant(s) and activating the hold control 522. Upon detecting activation of the hold control 522, the communication space station reports the indication to the communication space station management application 230. Upon receiving the indication, the communication space station management application 230 provide the indication to the packet voice/video gateway 232 which place the selected participant(s) on hold status and return updated status content to the communication space station management application 230.

The flow chart of Figure 12j represents steps performed by the communication space station management 32 upon receiving a subscriber indication of a video image selection from a communication space station 24. Step

426 represents such receipt by the communication space station management 32. Step 428 represents providing the video image selection to the packet gateway 232. The packet gateway 232 then begins relaying the selected video image to the subscriber station. At step 430 the communication space station management application 32 retrieves a style sheet for the display of the video image and at step 432 provides the style sheet to the communication space station 24. The communication space station management application 32 at step 434 provides instructions to display the video image received from the packet gateway 232 in conjunction with the style sheet.

Figure 16g represents an exemplary display of a single video image on the touch panel 72. The display include a control to return to the status page which, when activated, cause the communication space station 24 to return to the display of Figure 16f. The display also include a scroll video control 530 which, when activated cause the communication space station 24 to report such activation to the communication space station management 230. The communication space station management 32 perform the steps discussed with respect to Figure 12 with the selected image scrolled by one video image. The display also include a ¼ video control 528 which, when activated cause the communication space station 24 to report such activation o the communication space station management application 32. The communication space station management application perform the steps discussed with respect to Figures 12 but the packet gateway 232 provide a mixed video image comprising each of four video images arranged in the four corners of the display as represented by Figure 16h. From any of the displays associated with the conference call (e.g. Figure 16e, Figure 16f, Figure 16g, and Figure 16h, termination of the call cause the communication space station 24 to return to the main menu as represented by Figures 16a or 16b.

Content Application

The flowchart of Figure 13 represents and exemplary content application that supports the time and billing appliance module 30c. At step 700 a session is established with the appliance module support application 117 of a communication space station 24 that serves a time and billing appliance module 30c in it docking station 62b. A start up display content is selected at step 702 to provide to the

communication space station 24 with a display on the appliance module display. The start up display content may include a list of projects associated with the subscriber as shown in the display 476 of Figure 10. Step 704 represents providing the display content to the appliance module support appliance module support application 117. Thereafter, the content application waits for an indication of subscriber input that may include an indication of subscriber activation of the record button 468; the stop record button 470; the start time button 464; the end time button 466, or one of the scroll buttons 472 - 474 (all of Figure 10).

If the subscriber input is activation of the record button at step 706, the content application signals the record module 39 at step 708 to initiate recording of the audio or audio/video session in which the communication space station 24 is participating. If the subscriber input is activation of the step record button at step 710, the content application signals the record module 39 at step 712 to terminate recording of the audio or audio/video session in which the communication space station 24 is participating. If the subscriber input is activation of the start time button at step 714, the content application updates a time log to reflect a start time associated with the project highlighted by the subscriber at the time of button activation at step 716. If the subscriber input is activation of the end time button at step 718, the content application updates the time log to reflect an end time associated with the project highlighted by the subscriber at the time of button activation at step 720. If the subscriber input is activation of a scroll button at step 722, the content application updates the display content to reflect the scroll at step 724 and sends new display content at step 704.

It should be appreciated that the systems and methods of the present invention provides for a modular and configurable communication space station that supports a subscribers multimedia communication needs. Although the invention has been shown and described with respect to certain preferred embodiments, it is obvious that equivalents and modifications occur to others skilled in the art upon the reading and understanding of the specification. It is envisioned that after reading and understanding the present invention those skilled in the art may envision other processing states, events, and processing steps to further the objectives of the modular multi-media communication management

system of the present invention. The present invention includes all such equivalents and modifications, and is limited only by the scope of the following claims.